A Proposed Methodology to Analyze Macroprudential Policies

Presentation for the Closing Conference of the BIS CCA Research Network on "Incorporating Financial Stability Considerations into Central Bank Policy Models"

Mexico City, Jan. 29-30, 2015

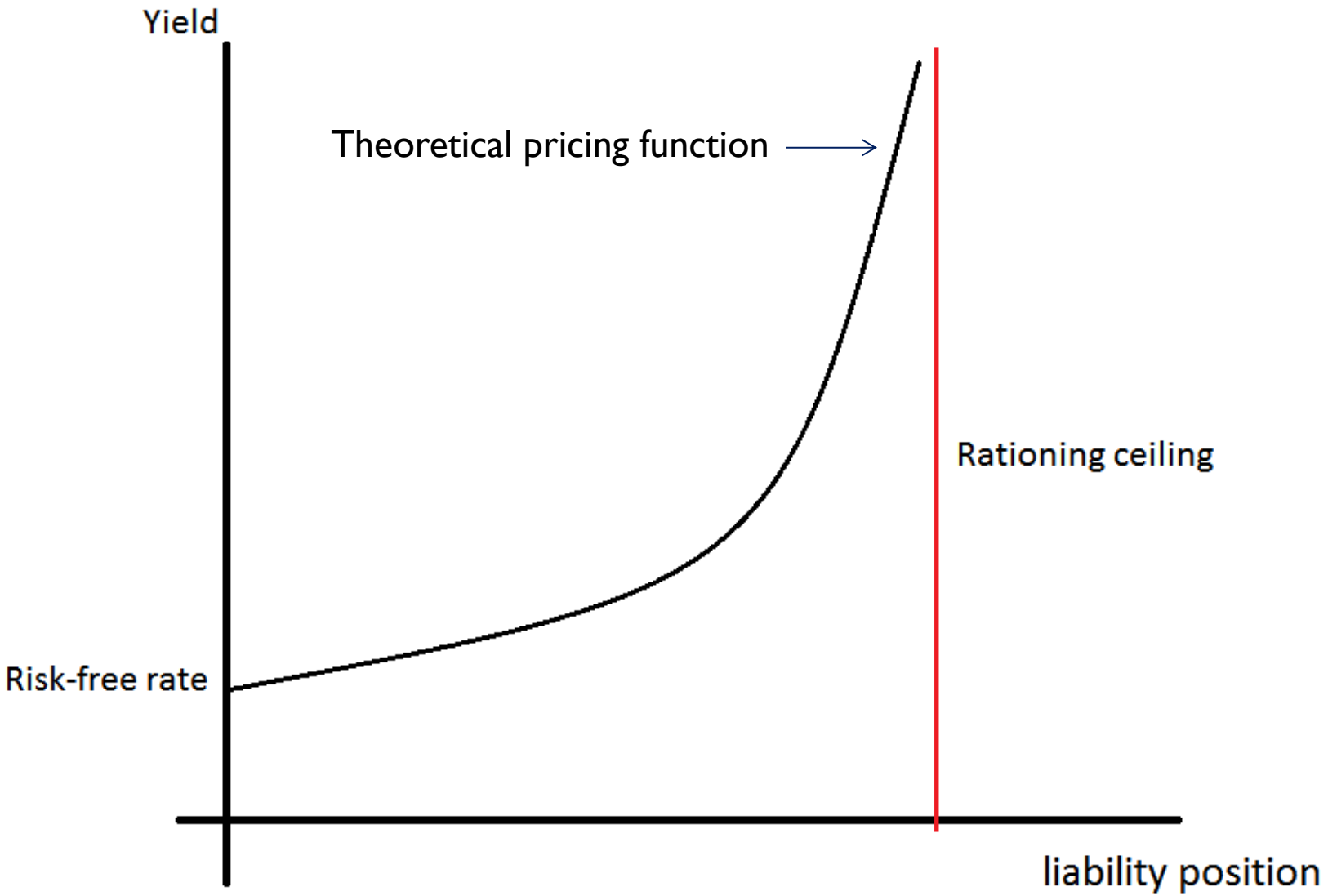
Proposed methodology

- Build quantitative non-linear financial crisis framework with three key features:
  1. Endogenous fin. amplification drives realistic crisis dynamics
  2. Explicit market failure justifies policy intervention
  3. Provides a mapping from MPP instruments to agents' incentives to targets and goals (frequency & magnitude)
- Background papers:
  1. "*Macroprudential Policy with News Shocks and Global Liquidity Regime-Switching*" by J. Bianchi and E.G. Mendoza (2015)
     - Appendix: Algorithm and instructions for Matlab code
  2. "*Optimal, Time-Consistent Macroprudential Policy*," by J. Bianchi and E.G. Mendoza (2013,2015)

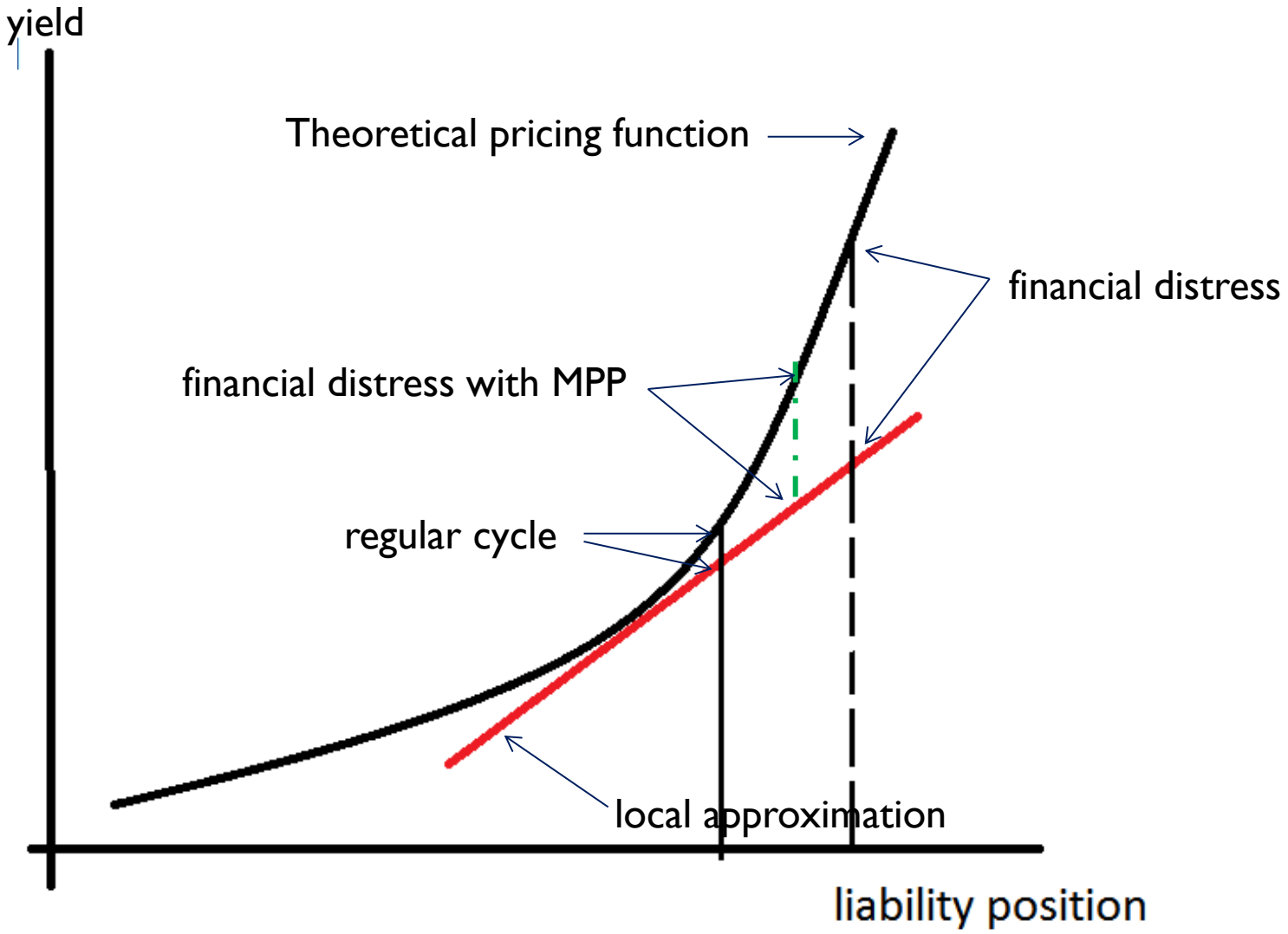
Layout of the presentation

1. Financial instability, amplification and nonlinearities: General argument
2. Crises framework: Collateral constraint causes Fisherian deflation & pecuniary externality
3. Show the model produces strong financial amplification and crises with realistic features
4. Solve for optimal policy and study its effectiveness (frequency, magnitude of crises)
5. Show importance of news shocks and global liquidity shifts

Pricing debts with financial instability



Amplification, nonlinearities and MPP



Non-linear financial crises framework

- Credit market frictions induce collateral constraints that depend on market prices
- Two key implications:

1. Amplification: Feedback loop between prices and borrowing capacity (Fisherian debt-deflation)
2. Pecuniary externality: Agents do not internalize how borrowing decisions made in "good times" affect collapse of collateral prices in a crisis

- Large literature on positive and normative implications: Financial Accelerator, EM Sudden Stops, Macroprudential Policy, etc

MPP with News & Global Liquidity Switches

- Start with canonical model of Sudden Stops/MPP (Mendoza (02), Bianchi (11), Benigno et al. (13)...)
  1. SOE with tradables & nontradables sectors
  2. Liability dollarization: debt denominated in tradables, backed-up by total income
  3. Fluctuations in relative price of nontradables affect borrowing capacity
- Add noisy but informative news about next-period's fundamentals (TFP, TOT, resources, etc)
- Add regime switches in global liquidity (interest rates or borrowing capacity)
- Solve DE without policy, constrained-efficient SP problem, and optimal MPP (debt taxes)

Decentralized Equilibrium: Households

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c).$$

$$c = \left[\omega \left(c^T \right)^{-\eta} + (1-\omega) \left(c^N \right)^{-\eta} \right]^{-\frac{1}{\eta}}, \eta > 1, \omega \in (0,1).$$

$$q_t b_{t+1} + c_t^T + p_t^N c_t^N = b_t + \pi_t^T + \pi_t^N + w_t \bar{h}$$

$$q_t b_{t+1} \geq -\kappa \left(x_t + w_t h_t + \pi_t^T + \pi_t^N \right).$$

Decentralized Equilibrium: Firms

$$\max_{h_t^T} \pi_t^T = A^T h_t^{T\alpha} - w_t h_t^T$$

$$\max_{h_t^N} \pi_t^N = p_t^N A^N h_t^{N\alpha} - w_t h_t^N$$

News shocks (Durdu et al. (2013))

- Signal s_t informs about x_{t+1} , with precision θ :

$$p(s_t = i|x_{t+1} = l) = \begin{cases} \theta & \text{if } i = l \\ \frac{1-\theta}{N-1} & \text{if } i \neq l \end{cases}$$

--Uninformative if $\theta = \frac{1}{N}$, perfectly informative if $\theta = 1$

- Conditional forecast probability:

$$p(x_{t+1} = l|s_t = i, x_t = j) = \frac{p(s_t = i|x_{t+1} = l)p(x_{t+1} = l|x_t = j)}{\sum_n p(s_t = i|x_{t+1} = n)p(x_{t+1} = n|x_t = j)}$$

- Joint (*s*,*x*) Markov transition probabilities:

$$\Pi(x_{t+1}, s_{t+1}, x_t, s_t) \equiv p(s_{t+1} = k, x_{t+1} = l|s_t = i, x_t = j)$$

$$= p(x_{t+1} = l|s_t = i, x_t = j) \sum_m [p(x_{t+2} = m|x_{t+1} = l)p(s_{t+1} = k|x_{t+2} = m)]$$

Global liquidity regimes

- Shifts in global liquidity result in regimes of persistently high or low real interest rates
- Standard two-point regime-switching process:
  1. Regimes:
  $$R^h > R^l$$
  2. Transition probabilities
  $$F_{hh} \equiv p(R_{t+1} = R^h \mid R_t = R^h)$$
  $$F_{ll} \equiv p(R_{t+1} = R^l \mid R_t = R^l)$$
  3. Mean durations:
  $$1/F_{hl} \quad 1/F_{lh}$$

Decentralized Eq.: Optimality conditions

$$\lambda_t = u_T(t)$$

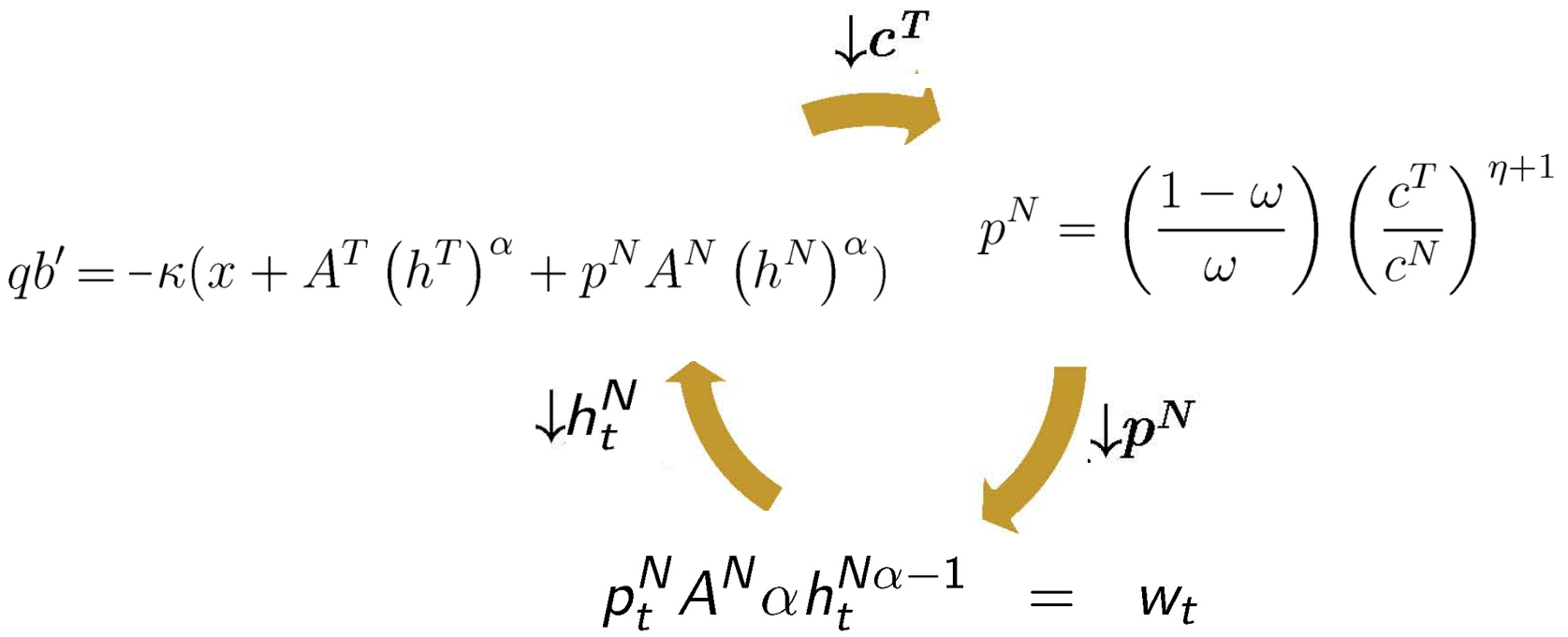
$$p_t^N = \left(\frac{1-\omega}{\omega}\right)\left(\frac{c_t^T}{c_t^N}\right)^{\eta+1}$$

$$\lambda_t = \frac{\beta}{q_t}\mathbb{E}_t\left[\lambda_{t+1} + \mu_t\right]$$

$$b_{t+1} + \kappa\left(x_t + w_t h_t + \pi_t^T + \pi_t^N\right) \geq 0$$

$$\begin{aligned} p_t^N A^N \alpha h_t^{N\alpha-1} &= w_t \\ A^T \alpha h_t^{T\alpha-1} &= w_t \end{aligned}$$

Financial amplification mechanism



Effects of news & liquidity regimes

- News effects:
  1. Good news at t strengthen incentives to borrow
  2. …and increase expected future borrowing capacity
  3. …but if followed by low x_{t+1}, prob. of crisis rises (higher leverage)
- Global liquidity shifts:
  1. Persistent high liquidity induces more borrowing
  2. Expectation of regime switch is low
  3. Shift to low liquidity after spell of high liquidity triggers severe crisis (low prob. by construction)
- DE and SP have identical information sets

Financial regulator (planner's) problem:

$$V(b,z) = \max_{p^N, h^T, h^N, c^T, c^N, b'} \left[u(\omega \left(c^T\right)^{-\eta} + (1-\omega)\left(c^N\right)^{-\eta-\frac{1}{\eta}}) + \beta \mathbb{E} V(b', z') \right]$$

$$c^T + qb' = b + A^T \left(h^T\right)^{\alpha}$$

$$\bar{h} = h^T + h^N$$

$$c^N = A^N \left(h^N\right)^{\alpha}$$

$$qb' \geq -\kappa(x + A^T \left(h^T\right)^{\alpha} + p^N A^N \left(h^N\right)^{\alpha})$$

$$p^N = \frac{A^T}{A^N} \left(\frac{h^T}{h^N}\right)^{\alpha-1}$$

$$p^N = \left(\frac{1-\omega}{\omega}\right) \left(\frac{c^T}{c^N}\right)^{\eta+1}$$

Externality & optimal policy

- Wedge in the marginal costs of borrowing in periods of financial stability ($\mu_t = 0$) :

1. DE: $$u_T(t) = \frac{\beta}{q_t}\mathbb{E}_t\left[u_T(t+1)\right]$$

2. SP: $$u_T(t) = \frac{\beta}{q_t}\mathbb{E}_t\left[u_T(t+1) + \mu_{t+1}\psi_{t+1}\right]$$

$$\psi_t \equiv \kappa\left[\frac{A_t^T\bar{h}(1-\alpha)(h_t^T)^{\alpha-2}}{\alpha A_t^T(h_t^T)^{\alpha-1} - \phi(h_t^T)}\right]$$

- Optimal debt tax:

$$\tau_t = \frac{\mathbb{E}_t\left[\mu_{t+1}\psi_{t+1}\right]}{\mathbb{E}_t\left[u_T(t+1)\right]}$$

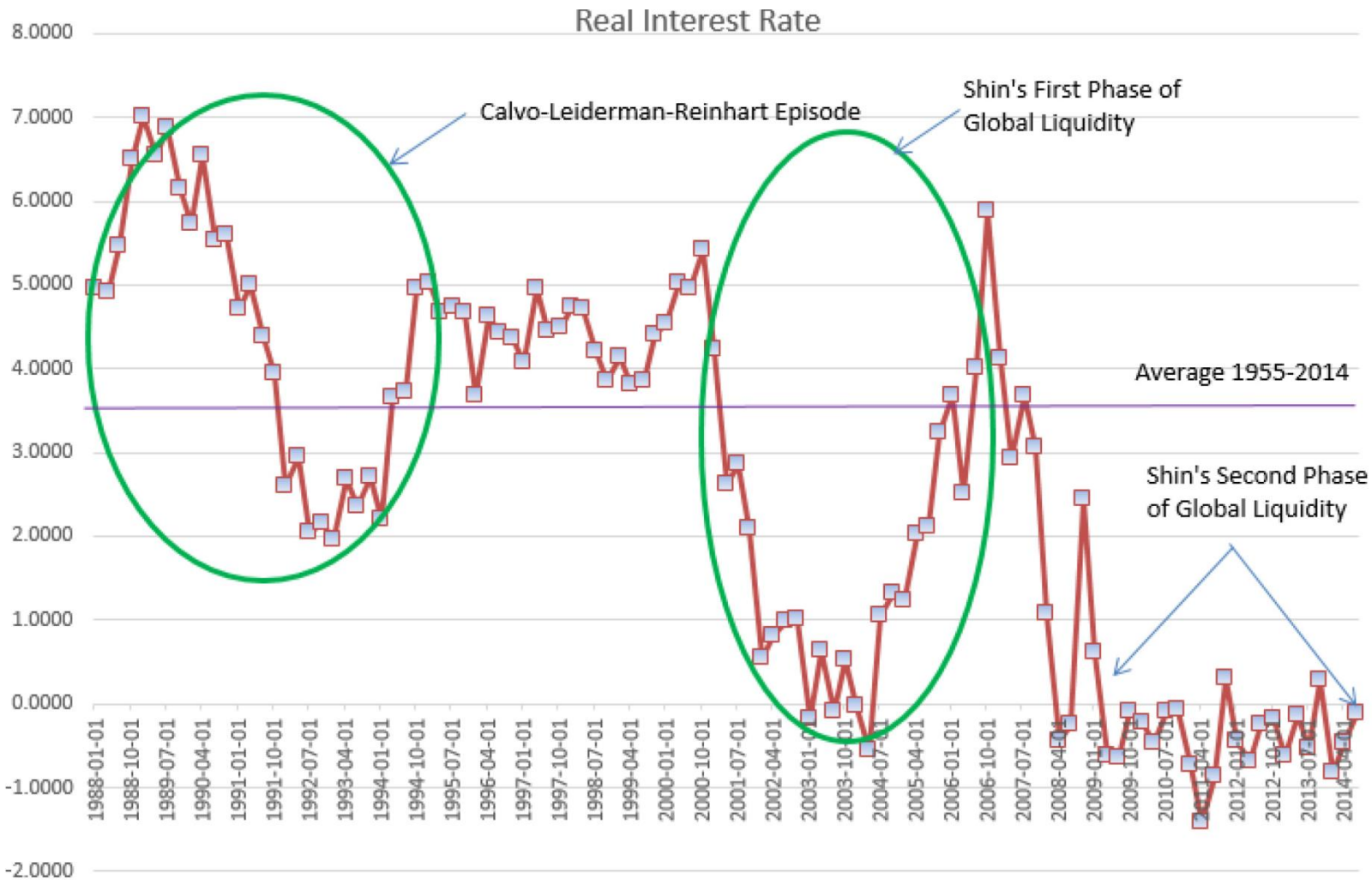
Questions for quantitative analysis:

1. Does the Fisherian mechanism produce strong financial amplification and crisis dynamics?
2. Do news shocks and global liquidity shifts add to this mechanism?
3. Is MPP effective to reduce frequency and magnitude of fin. crises?
4. How does news precision affect effectiveness?
5. Does it matter what the signals are about?
6. How complex is the optimal policy (i.e. how does it vary across news and liquidity regimes)

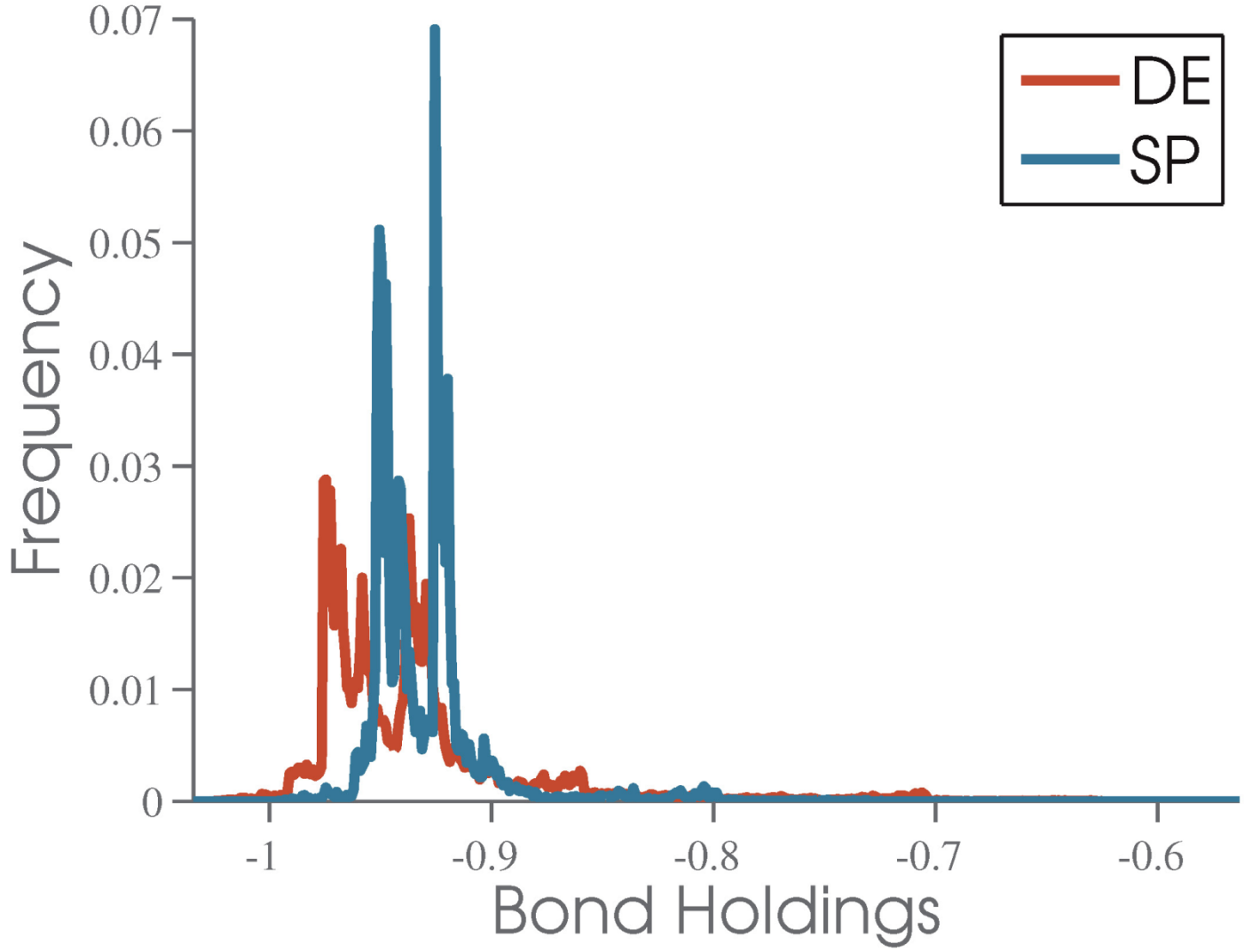
Baseline Calibration a'la Bianchi (11) (endowment economy case)

y^N	1
N_{y^T}	3
$E[y^T]$	1
ρ_{y^T}	0.54
σ_{y^T}	0.059
β	0.91
γ	2
η	0.205
κ_L	0.32
ω	0.31
θ	$\frac{2}{3}$
R^h	1.0369
R^l	1.0
F_{hh}	0.9833
F_{ll}	0.9

Global liquidity phases



Baseline results: Long-run dist. of NFA



Baseline results: Main moments

Long-run Moments	(1) DE	(2) SP
$E[B/Y]$	29.74%	29.58%
$\sigma(CA/Y)$	0.0233	0.0126
Welfare Gain	0.08%	na
Prob of Crisis	3.5%	2.0%

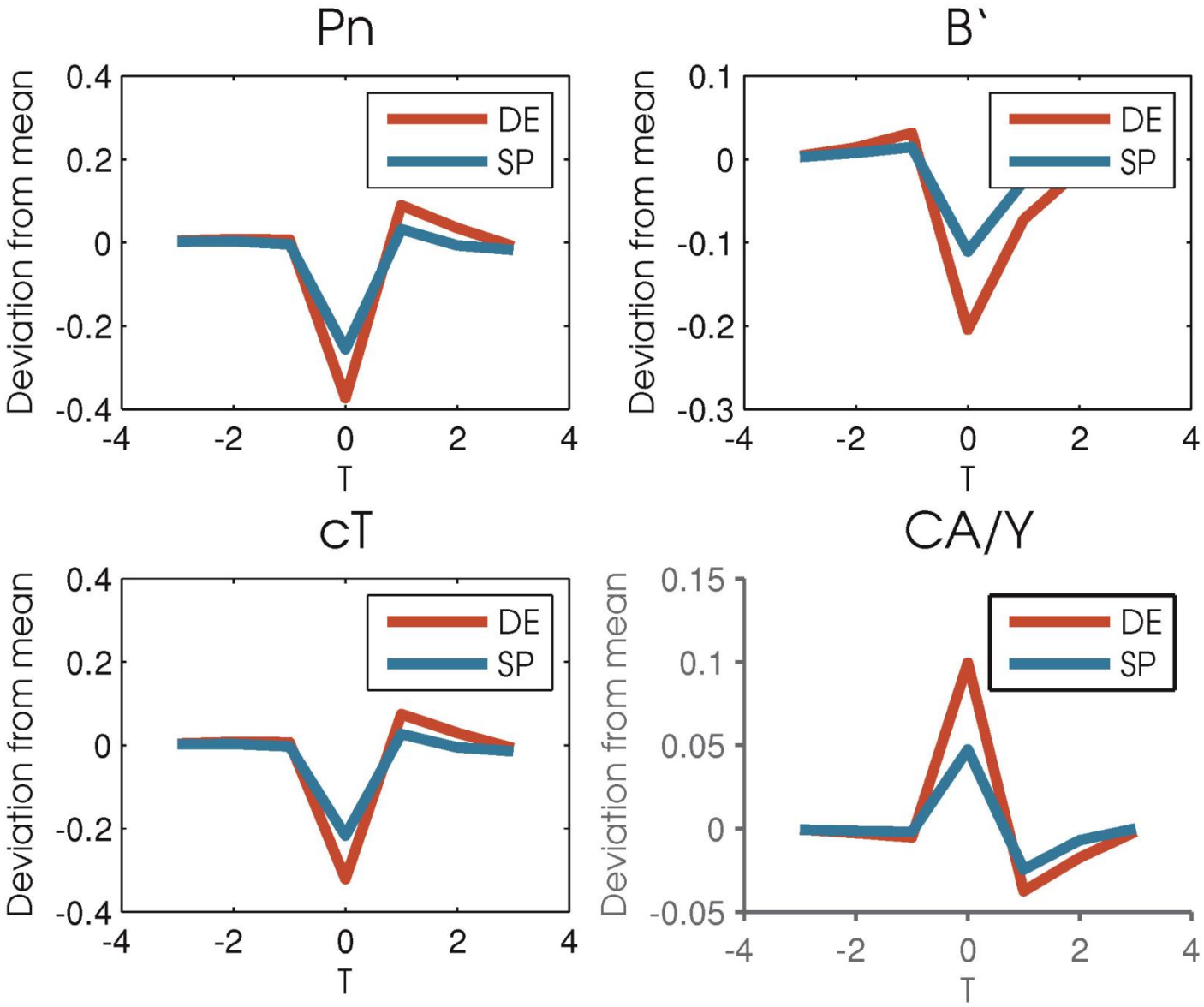
Financial Crisis Moments		
ΔC	-11.67%	-7.44%
ΔRER	37.11%	22.13%
$\Delta CA/Y$	10.02%	4.78%
Δy^T	-9.91%	-9.91%
Ω^C	4.46	2.55
Ω^{RER}	5.29	2.79
$\Omega^{CA/Y}$	10.55%	5.15%
$E[\tau]$ pre-crisis	3.82%	na

Effective policy

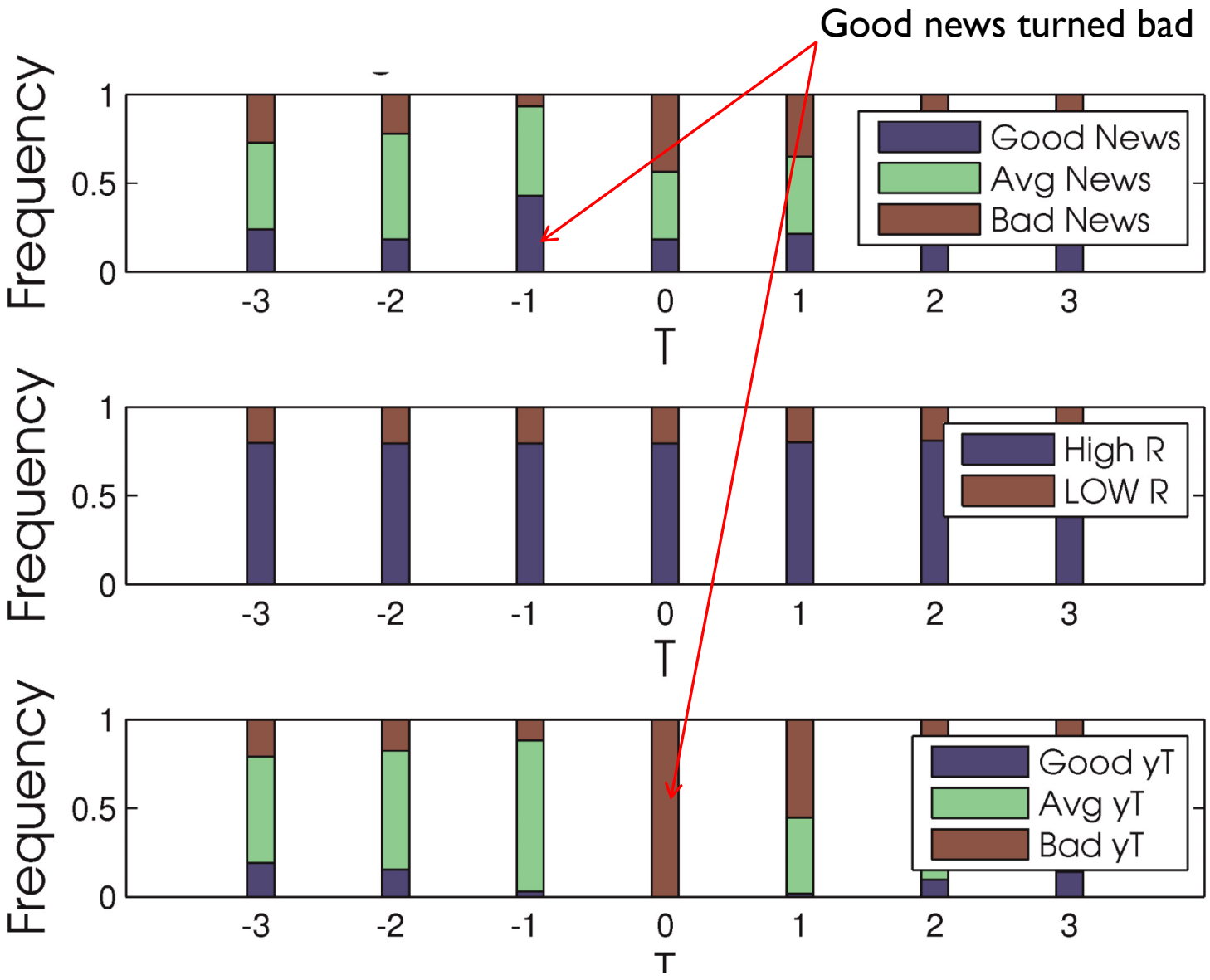
Large crises

Large amplification

Financial crises events



Shocks during crisis events



Effects of higher signal precision

Non-monotonic effect on crisis probs.

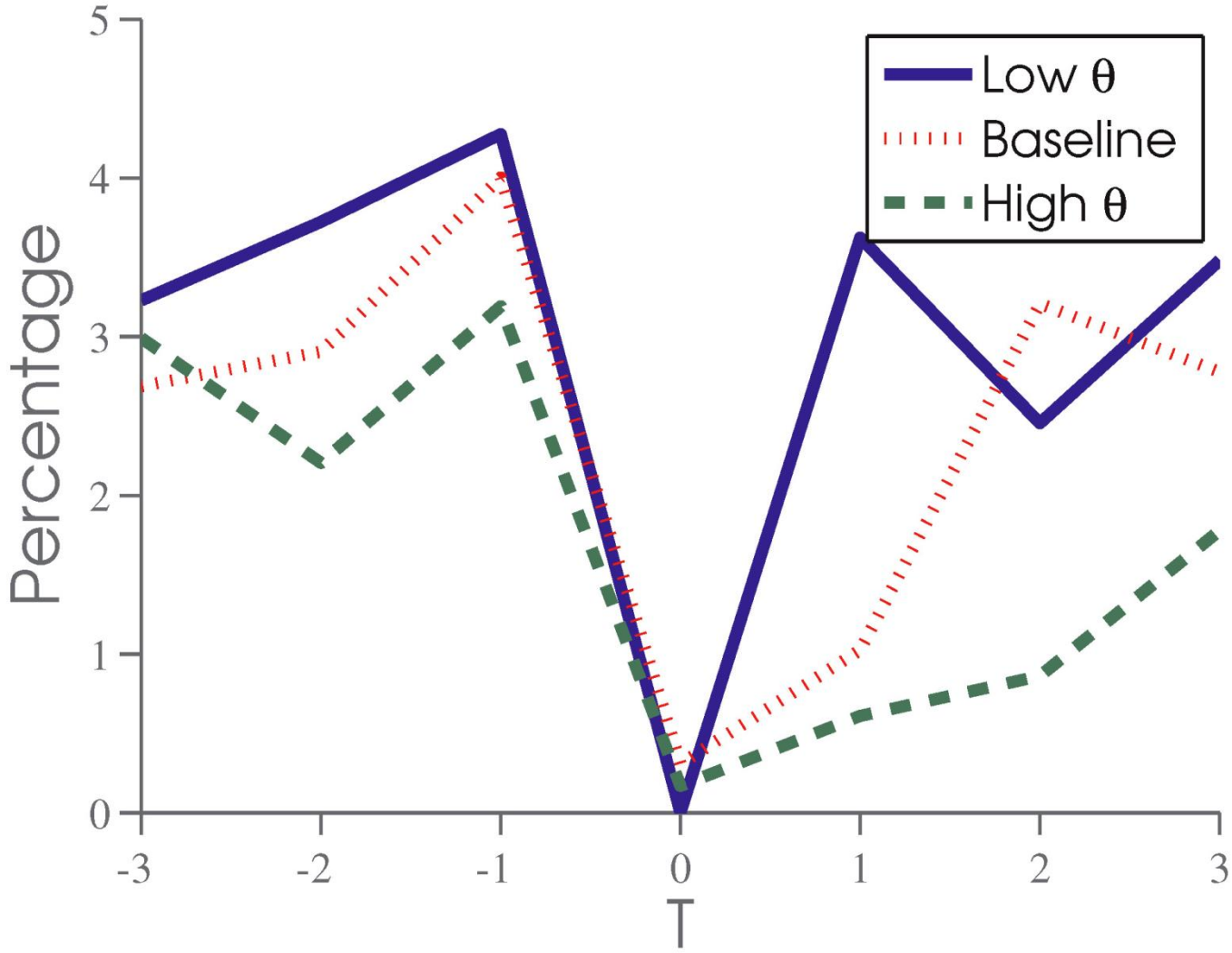
θ	(1) **0.35**		(2) **0.55**		(3) **0.66**		(4) **0.75**		(5) **0.95**	
Long-run Moments	DE	SP	DE	SP	DE	SP	DE	SP	DE	SP
$E[B/Y]$ (%)	29.41	29.35	29.55	29.45	29.76	29.58	29.98	29.76	31.32	31.18
$\sigma(CA/Y)$	0.019	0.007	0.021	0.009	0.023	0.013	0.025	0.015	0.028	0.024
Prob of Crisis (%)	3.5	0.0	4.3	0.5	3.4	2	2.7	2.1	0.8	0.6
Welfare Gain (%)	0.082	na	0.08	na	0.08	na	0.08	na	0.048	na

Financial Crisis Moments										
ΔC (%)	-8.6	-4.9	-9.9	-6.1	-11.6	-7.4	-13.8	-9.2	-20.9	-20.9
ΔRER (%)	25.9	14.1	30.5	17.7	37.6	22.1	45.6	28.2	83.5	80.9
$\Delta CA/Y$ (%)	6.3	2.0	7.8	3.2	10.2	4.8	12.7	6.9	23.7	18.5
Δy^T (%)	-9.93	-9.93	-9.88	-9.88	-9.91	-9.91	-9.89	-9.89	-9	-9.4
$E[\tau]$ pre-crisis (%)	4.27	na	4.05	na	4.05	na	3.61	na	3.19	na

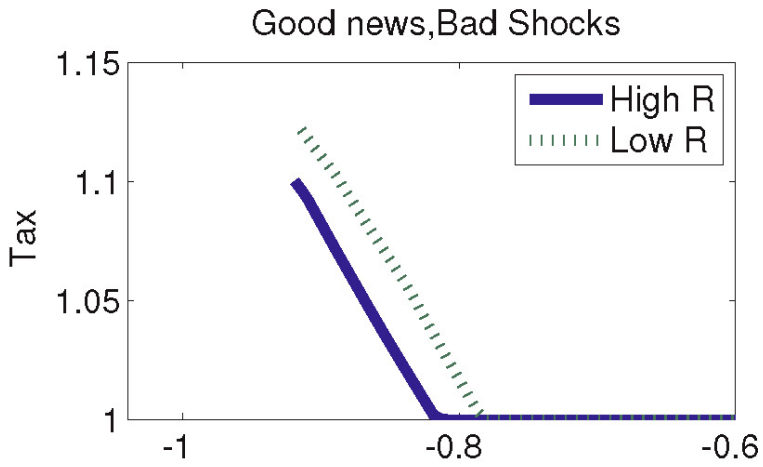
Magnitude of crises increases

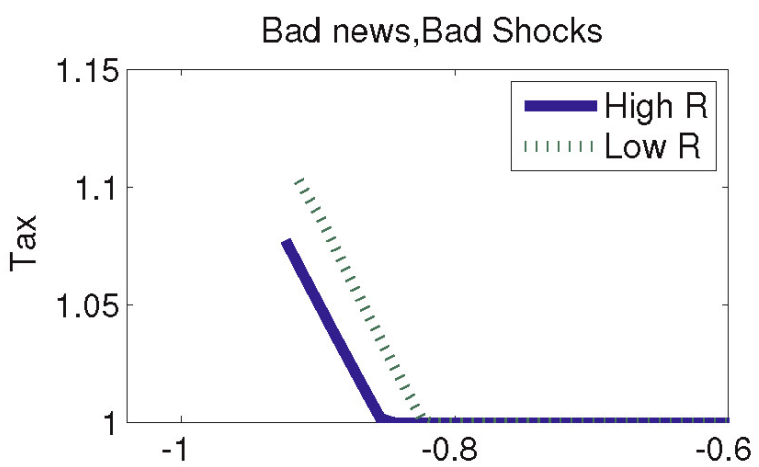
Effectiveness of optimal MPP diminishes

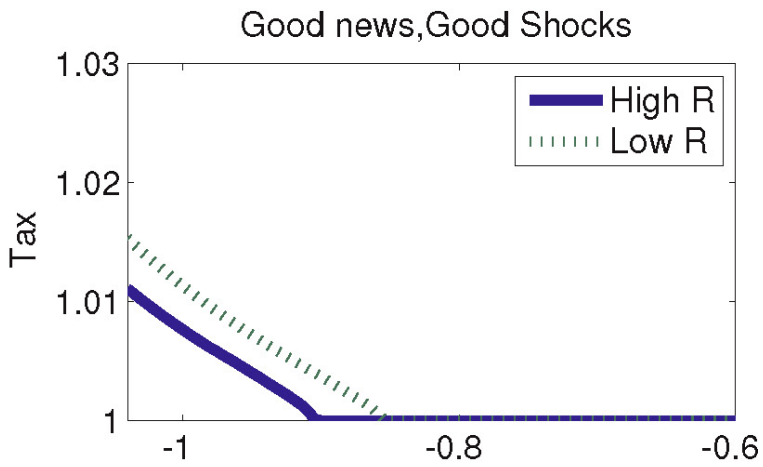
Optimal MP debt tax around crises

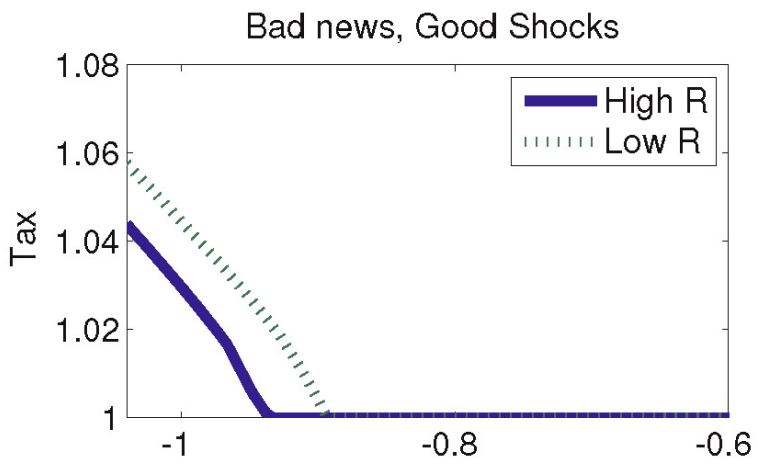


Optimal tax schedule & global liquidity

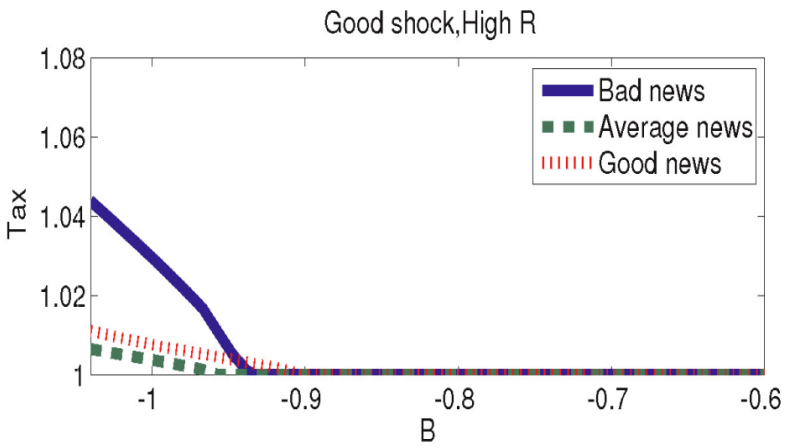


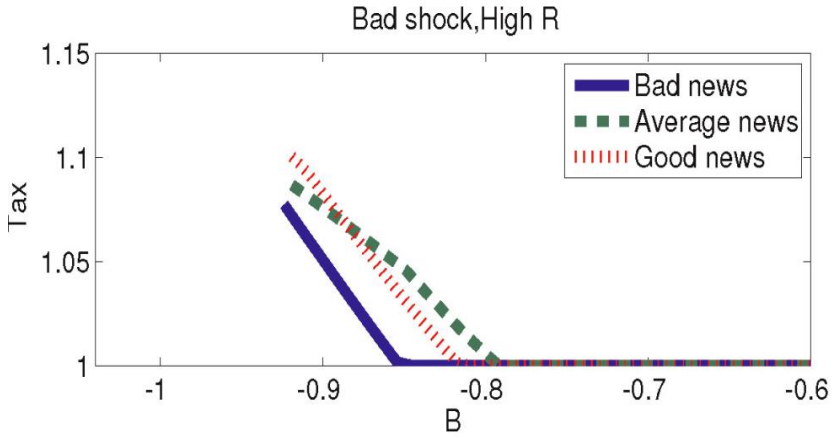


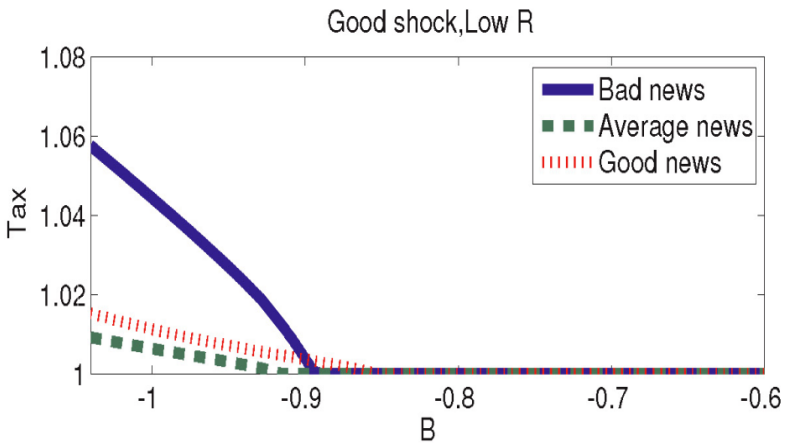


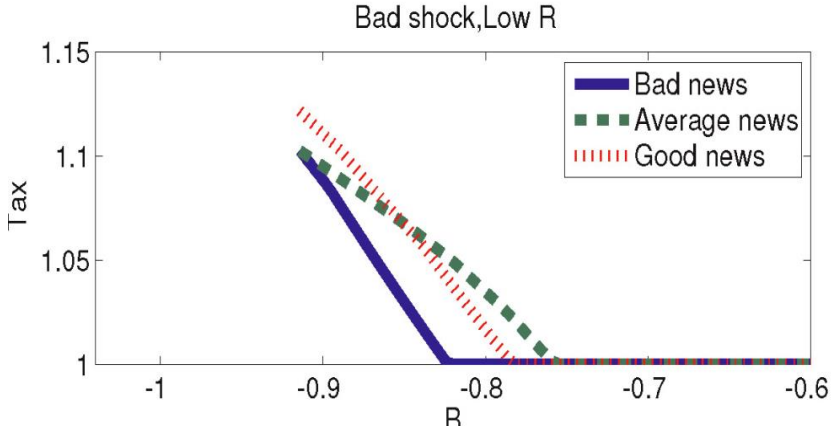


Optimal tax & news shocks









Different news shocks

Model Moment	(1) κ news		(2) y^T news, R		(3) y^T news, κ		(4) R news	
Long-run Moments	DE	SP	DE	SP	DE	SP	DE	SP
$\sigma(CA/Y)$	0.0327		0.0231		0.0262		0.0321	
Welfare Gain (%)	0.115		0.079		0.077		0.063	
$E[B/Y]$ (%)	-28.31		-29.72		-28.55		-29.51	
Prob of Crisis	4.3%	0.02%	3.6%	2%	3.24%	1.78%	2.09%	0.52%
Financial Crisis Moments								
ΔC	-15.42%	-10.26%	-11.53%	-7.46%	-12.3%	-8.24%	20.55%	17.5%
ΔRER	52.52%	32.25%	36.69%	22.17%	40.7%	25.45%	77.04%	62.12%
$\Delta CA/Y$	14%	7.2%	9.86%	4.78%	11.3%	6%	19.9%	15.4%
Δy^T (%)	-12.4%		-9.94%		-9.06%		-15.6%	
$E[\tau]$ pre-crisis	4.74%		4.29%		3.48%		11.34%	

Assets as collateral

- Bianchi & Mendoza (2013) consider:

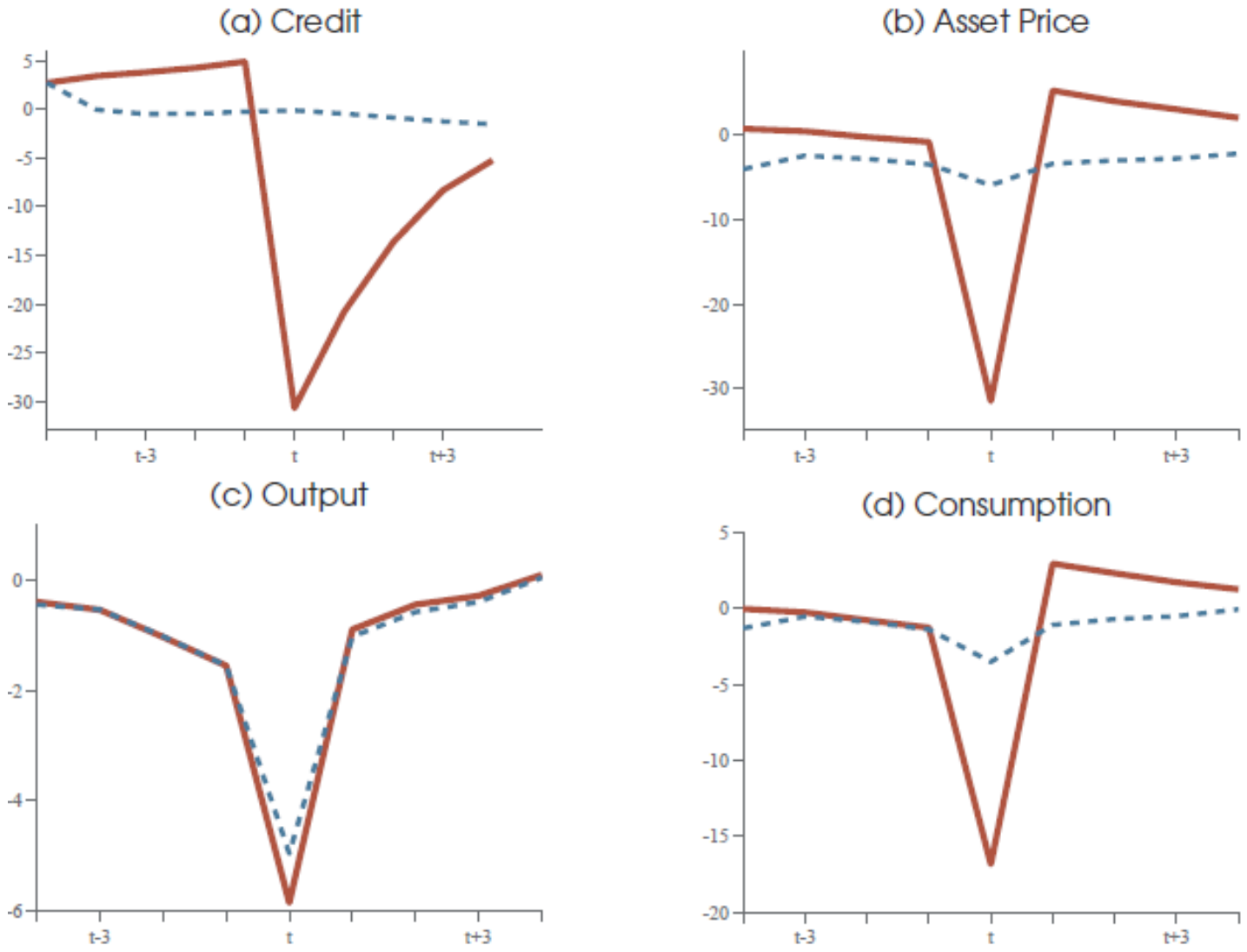
$$-\frac{b_{t+1}}{R} + \theta p_m m_t \leq \kappa_t q_t k_t$$

  - Physical assets valued at market price used as collateral
  - Collateral used for both intertemporal debt & working capital
- Pecuniary externality yields this wedge:

$$u'(c_t) = \beta R \mathbb{E}_t \left\{ u'(c_{t+1}) - \kappa \mu_{t+1} q_{t+1} \frac{u''(c_{t+1})}{u'(c_{t+1})} \right\}$$

- Analogous results about MPP effectiveness
- …but debt tax lacks credibility under commitment (time inconsistency), so optimal policy must also align incentives of future financial regulators

Effectiveness of Optimal MPP



Conclusions

- Fisherian models provide useful quantitative framework for studying financial amplification & crisis dynamics, and for evaluating MPP
- News shocks and global liquidity regimes strengthen Fisherian amplification mechanism
- MPP remains effective, but it becomes more complex (varies with news & liquidity regimes)
- Future work: Production model, financial frictions in supply side, simpler policies (Financial Taylor Rule)